the white house, whilst the tree was still almost bare of leaves. Not wishing for the noise and dirt so near the windows, I removed it, and they began another; again it was removed, and this time, though apparently little more than a flat beginning, it had eggs upon it. They tried again, and on removing it the third time I found that the birds were overlaying it on all sides with the flowers of some sweet Alyssum that was growing below; the intention being, evidently, to render it more like the background of white wall, and therefore less conspicuous.

Sidmouth. J. M. H.

Earthquakes and the Suspended Magnet.

DURING the afternoon of May 3 at Lyons, N.Y., a peculiar quivering motion of the suspended magnet was noted, especially at about 1 o'clock p.m., and a strong westward deflection continued during the afternoon. Similar phenomena have been noted repeatedly when earthquakes were in progress, in this case the shock being quite severe, and occurring at 3.8 p.m. at El Paso, Texas. M. A. VEEDER.

Lyons, N.Y., May 4

Units of Weight, Mass, and Force.

THE letter of Prof. Greenhill (NATURE, vol. xxxv. p. 486) is both timely and suggestive. Herbert Spencer's chapter on space, time, matter, motion, and force, supplemented by his chapter on the persistence of force, in "First Principles of Philosophy," gives all that can be desired by the student for a complete comprehension of the subject. One who assimilates the basic truths there so clearly given need never be perplexed by any statement found in the mechanical and mathematical text-books. It is simply impossible to use language in regard to these matters without employing expressions that are true only in a certain sense. We say that "the sun rises" and "the sun sets," and that "the heavens revolve." If these words are used to indicate the cause of the progressive shadows on a sun-dial, or the time of day, they serve a practical need as well as if they were true. But a student who should infer the constitution of the solar system from such phrases would go far astray.

When the significance of Spencer's explanation of motion is grasped, a great part of the ambiguity will have vanished. We constantly think of motion as an entity, which is a pure delusion. We also say of force that it is the cause of motion. Nothing can be more untrue. Force is the cause of change of motion only There is not a conceivable difference between rest and motion otherwise than as the expression of a relation. Whether a body be at rest or in motion depends wholly upon the body to which it is related.

When the student sees that motion is no entity, and is familiar with the process by which the conceptions of matter, force, space, and time, are built up from sensations, he will be in no danger of mistaking the sense in which certain text-book statements are to be taken, much less will he be captured by those in which the errors are unpardonable. I. LANCASTER.

Chicago, Ill., April 28.

WITH regard to Mr. Geoghegan's letter in your issue of April 7 (vol. xxxv. p. 534), my experience in teaching physics long ago led me to the same conclusions. For three years I have used in my classes in this the oldest existing University in Ontario, and with the greatest advantage, the terms *tach*, *gram-tach*, *prem*, and *dyntach* for the units of velocity, momentum, pressure-intensity, and rate of working respectively, in the C.G.S. system of units. These may be found in my "Introduction to Dynamics," which was printed last year for my junior class. *Prem* was chosen after failure to get a euphonious monosyllable from the Greek. A name for the unit of acceleration I have not found to be necessary. *Vel* seems to me to be a good word for the unit of velocity in the F.P.S. system of units, but, for fear of hanging on a sour apple-tree, I would shudder to mention *pound-vel* and *poundal-vel*. The term *squeeze* would be suitable in several respects for a *poundal per square foot*, but in mixed classes, such as we have here, it might lead to disorder.

D. H. MARSHALL.

Queen's University, Kingston, Ontario, Canada, April 27.

Remarkable Phenomenon seen on April 26, 1887.

A PHENOMENON was seen here this evening quite distinct from anything I have before observed. It was an exact copy of streams of aurora borealis rising from a low arch, but instead of being in the northern heavens it was near the south horizon. The sky was cloudless, except a long thundercloud which extended from near south-south-west to almost south-south-east, the upper portion of this cloud being about 12° above the horizon. From this cloud issued from one to three streams of conspicuous white light, the north-easterly stream being the largest and brightest, and this continued visible from 9.40 until 10.5 (the others were only seen for five minutes). The streams were at an angle of about 53°, and moved slowly easterly (the cloud moving in the same direction). The longest stream reached an altitude of 25°, and at 10 o'clock exactly (G.M.T.) the base was immediately over the Avonmouth Lighthouse. The light of the streams was more persistent and less flickering than is usually the case with aurora borealis.

There was also a confused luminosity behind the cloud, which varied considerably in brightness; this made the outline of the cloud at one time distinctly visible, and at another scarcely discernible; this also gave the clouds a black appearance. After 10 p.m. other clouds rose above the cumulo-stratus, and the streams became hid. Three hours afterwards there was a snowstorm, and the ground was white till 7 a.m. Reports from Somerset, Dorset, and Devon would be valuable.

Shirenewton Hall, near Chepstow. E. J. LOWE.

Pear-shaped Hailstones.

ARE pear-shaped hailstones as uncommon as some of your correspondents suppose?

We have had here to-day a succession of heavy showers of rain and hail together, the hailstones being small, but many of them pear-shaped, and the rest of shapes which might easily have been derived from that form by attrition or partial melting.

About half past six this evening we had a storm of hail only, heavier than any that preceded it, in which nearly or quite all the stones were pear-shaped, from a fifth to a third of an inch in diameter. B. WOODD SMITH.

Penmaenmawr, N. Wales, May 20.

P.S.—May 21. At 9.30 this morning we had another shower of hail and rain, in which the stones showed no sign of any pear-shape, but were of irregular rounded forms.

"A Junior Course of Practical Zoology."

IN the review of Messrs. Marshall and Hurst's book referred to in my friend Prof. Bourne's letter, I sought to compare that work with others devoted to the familiar type-system, to which alone the words "all other books current" were meant by me to refer, to the exclusion of general text-books such as those from which he quotes. I admit that I might have made my meaning somewhat plainer than I did, and would beg to be allowed to state that I had it in my mind, at the time of writing, to refer the reader to the impartial statements made on the subject in question by Prof. Rolleston in his "Forms of Animal Life"; the first of the series of what we are now pleased to term "type" or "junior course" books.

With respect to my critic's second objection, I would ask the readers of NATURE to judge for themselves how far the quotations which he so skilfully weaves into his letter do justice to my contention. His view is, like my own, but an expression of opinion, and time alone can show which of the two will come nearest the truth. G. B. H.

South Kensington.

Bishop's Ring.

THE letter by Prof. G. H. Stone in NATURE, vol. xxxv. p. 581, is interesting, as showing the disappearance of "Bishop's ring" in Colorado. It has not wholly disappeared here, being still plainly visible about sunset. In the middle of the day, however, I have rarely seen any trace of its red colour since May last year; but up to that time, although growing much fainter, it was still frequently plain here, and I also saw it in the south of England, both in May and June 1886, but only feebly. Since then, when there has been a slight tinge of red, it has usually

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appeared of a dirty brown colour, very different from what "Bishop's ring" used to be, and I have thought that often it has not been in the upper atmosphere, but at a lower altitude, and most visible when there has been more or less smoke; so that it seemed not improbable the smoke was the cause of it. Has anyone else noticed such a phenomenon connected with smoke? "Bishop's ring," as still seen at sunset, is evidently not caused by smoke, but doubtless arises from the same circumstances as made it so conspicuous an object at its first appearance in November 1883, and gradually less so since.

The whitish wisps occurring in and near the ring about sunrise and sunset continued visible at intervals, and varying greatly in distinctness, up to the 31st ult. I have not seen them since, but they have been invisible for longer periods before.

T. W. BACKHOUSE.

Sunderland.

A REVIEW OF LIGHTHOUSE WORK AND ECONOMY IN THE UNITED KINGDOM DURING THE PAST FIFTY YEARS

I.

IT may be useful to recapitulate very briefly the various steps of progress in this important branch of engineering and optical enterprise since the beginning of the Queen's reign. And a few words may be added on the statistics and economics of the subject.

A lighthouse or lightship is naturally to be considered under four heads: (1) tower or hull and its lantern; (2) optical apparatus and its mechanical accessories; (3) lamps and illuminants; (4) auxiliary sound signals.

In 1837 a high degree of excellence had been attained in the first division, at least as regards stone towers and wooden vessels, but in the others *stare super antiquas vias* was a practice largely submitted to. The number also of established lights was comparatively small, about seventy of all kinds being in England and Wales, less than one-fifth of the present number. France, where there had been from 1824 to 1827 an active movement in the direction of coast illumination, possessed in 1836 about 100 lights. In 1822, and again in 1834 a Parliamentary Committee had inquired into the character and management of our lighthouses, with results to be noticed by and by.

In 1837 the old working Phari of Greece, Carthage, and Rome, from Alexandria to the Pillars of Hercules, had long since disappeared, leaving only a few vestiges, chiefly on the shores of France, Spain, and Britain. Of modern times the most notable towers were, on the Continent, the imposing Cordouan at the mouth of the Garonne (1610), and the tourist-haunted Lanterna of Genoa, the latter still being the tallest lighthouse structure in the world; while at home Smeaton's Eddystone (1759), prototype of British towers, the Bell Rock (1811), the Tuskar (1815), and the Carlingford, on Haulbowline Rock (1823), stood as the most striking examples of such edifices. But in 1838 the great tower of Skerryvore was begun by Alan Stevenson, whose father, Robert, had built the Bell Rock Lighthouse. These accomplished engineers have respectively left a graphic and instructive narrative of their work, which may be fitly classed with Smeaton's memorable account of the third Eddystone.

Skerrymhore or Skerryvore (*ysgar-mawr* = great divided cliff, or rocky islet, as in *scar*, or the hills Skerid Fawr, and Skerid Fach) is a nearly submerged reef adjacent to the Island of Tyree, exposed to the full force of the Atlantic, and surrounded by innumerable rocky points constituting "foul ground" along a line of seven miles. It is thus perhaps the most dangerous of all the *skerries* in British waters, and differs essentially from the Eddystone, which, though formidable in itself, rises from the deep sea, and can be approached more nearly in calm weather. Obviously, then, the 72 feet of elevation of the Eddystone lantern-centre, and even the 93 feet of the Bell Rock, could not afford the necessary range to a light intended to give timely notice to mariners of the outlying perils, and a height of 130 feet was adopted for the Skerryvore edifice, which, permitting one of 150 feet from focal plane to high water, insured a geographical horizon of about fourteen nautical miles, or eighteen miles to a vessel's deck. The mean diameter given to this tower was 29 feet, slightly greater than that of Bell Rock, that of Smeaton's Eddystone being 21 feet. The cubic contents are more than four times those of the Eddystone, and more than double those of Bell Rock. There are ten stories below the lantern, for water, fuel, keepers' rooms, and other purposes. The work was completed early in 1844, after extraordinary difficulties and perils, and it is a splendid monument to the energy and skill of Alan Stevenson. Its cost was £87,000.

Yet perhaps some of the towers of the great nation which charges no dues for its lights, but presents them a noble offering to the world, are fully as remarkable. Minot's Ledge (1859) on the Massachusetts coast, and Spectacle Reef, Lake Huron, are examples. The latter structure was begun in 1871, and, though for an inland water, cost £60,000, the special difficulty having been ice, and the laying, by means of a cofferdam, of the lower courses of masonry on a jagged slope of dolomitic limestone 12 feet under water, and eleven miles from land, like the Eddystone. So in the case of Minot's Ledge Tower, the foundations of which were laid on a rock barely visible at extreme low tide, and in the full swell of the ocean, the distinguished engineer General Alexander was able to secure but thirty hours of work in the first year, and 157 in the second.

The Bishop Lighthouse, on the south westernmost rock of the Scilly Islands, was completed in 1858 at a cost of £34,560. After a quarter of a century's service it has been found expedient to increase the height, and to erect a more powerful optical apparatus, which will be ready during the present year. Other notable towers of the Trinity House are the Smalls (entrance of Bristol Channel), the Hanois (west end of Guernsey), the Wolf, and the new Longships; all being generally alike in design, and not differing widely in dimensions and cost. The Wolf Tower received its light in January 1870, having been begun in March 1862. It was planned by Mr. James Walker, then Engineer to the Trinity House, but carried out by his successor, Mr., now Sir James, Douglass, and by his brother, Mr. William Douglass. This lighthouse is situated seventeen miles from Penzance, and twenty-three west-north-west of the Lizard. It has a mean diameter of nearly 30 feet, and a total height of 110 feet from high water to lantern-centre, being solid for 39 feet from the base, and containing 44,500 cubic feet of granite, weighing 3300 tons. Each face-stone is dovetailed vertically and also horizontally—the latter was not done in the Eddystone tower—and the courses further secured together by metal bolts. Roman cement was used for the work below water, and Portland cement for that above, the whole mixed with a peculiar granitic sand from a Cornish tin-mine. Very great difficulty, as with all these exposed towers, was experienced in the erection of the Wolf and the new Longships, owing to the terrific seas that assaulted the rocks. The Longships, so conspicuous an object from the Land's End, and so well known from Mr. Brett's luminous pictures, with an original elevation of 79 feet above high water, was so drowned by the waves that the character of the light could hardly be discerned, and a granite column of 110 feet was adopted.

In Scotland the sea-tower of Dubh Artach, or, less correctly, Dhu Heartach (1872), and in the Isle of Man that on the Chicken Rock (1875), may be named and the list of the chief structures of this type may be summed up in the Eddystone of Sir James Douglass, from which a light was first shown in 1882. The rapid disintegration of that part of the reef on which Smeaton's tower stood made it absolutely clear in 1877 that a new tower must be built if a

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